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ABSTRACT

A detailed description is provided of the methodology that was used to develop the concordance tables reported in a recent study by G. L. Marco and A. A. Abdel-fattah (1991) on the relationships between scores on the enhanced American College Testing (ACT) Program Assessment and the Scholastic Aptitude Test (SAT). Fourteen large universities provided data on applicants who had taken both tests. ACT Composite scores and the SAT-verbal and SAT-mathematics scores used in the study came from 1989 and 1990 administrations to 40,492 students. A subsample of 40,051 students who took the 2 tests no more than 217 days apart was also used. The equipercentile procedure, a curvilinear procedure, was used to scale the scores. Steps were taken to ensure the accuracy of the conversions by weighting the scores to reduce or eliminate the effect of time differentials between ACT and SAT testings, or smoothing the score distributions before scaling. The score conversions derived by applying the weighting procedures provided score adjustments that were in the direction implied by the length of time between testings. Four figures and five tables present analysis data, and there is an appendix commenting on statistics used. (Author/SLD)

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College Board Report

No. 92-3

Methods Used to Establish Score Comparability on the Enhanced ACT Assessment and the SAT®

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Patricia A. Baron

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ABSTRACT

Recently Marco and Abdel-fattah (1991) reported newly established relationships between scores on the enhanced American College Testing Program (ACT) Assessment and scores on the College Board's Scholastic Aptitude Test (SAT). The current report provides a detailed description of the methodology that was used to develop the "concordance" tables reported in that study.

Fourteen large universities provided data on applicants who had taken both the enhanced ACT Assessment and the SAT. The ACT Composite scores and the SAT-verbal and SAT-mathematical (SAT-V + M) scores used in the comparability study came from ACT Assessment test editions administered from October 1989 to June 1990 and SAT editions administered from March 1989 to June 1990. The total sample consisted of 40,492 students. A subsample of 40,051 students who took the enhanced ACT Assessment and the SAT no more than 217 days apart was also used in the comparability study.

The equipercentile procedure, a curvilinear procedure, was used to scale the scores. Steps were taken to ensure the accuracy of the conversions by (1) weighting the scores to reduce or eliminate the effect of the time differential between ACT and SAT testings or (2) smoothing the score distributions before scaling. The score conversions derived by applying the weighting procedures provided score adjustments that were in the direction implied by the length of time between testings.

INTRODUCTION

This report describes the methods used to establish comparability between scores on the ACT Composite from the enhanced ACT Assessment and scores on the SAT-verbal and SAT-mathematical composite (SAT-V + M). The results of the comparability study were reported earlier in *College and University* (Marco and Abdel-fattah 1991). Tables showing the concordance between scores on the ACT Composite and the SAT-V + M score are needed because institutional users frequently do not have ACT Assessment or SAT scores on all applicants for admission or scholarships. Thus, they must sometimes substitute estimated scores from one test for missing scores on the other. Although several ACT-SAT concordance tables are available, including those developed at user institutions, they do not provide score relationships between the SAT and the enhanced ACT Assessment, which was introduced in October 1989 and yields scores on a revised score scale.

Developing and interpreting the conversion results involve certain difficulties. Although it is mathematically possible to convert SAT scores to ACT Composite scores, or vice versa, the conversion process does not necessarily ensure that the resulting scores can be used interchangeably. Strictly speaking, it is impossible to make scores on the ACT Composite and the SAT-V + M strictly equivalent for each test taker, because one of the tests may measure the knowledge, skill, or ability of a particular test taker better than the other test does. The ACT Assessment and the SAT contain questions that cover somewhat different content. The enhanced ACT Assessment contains subtests in English (45 minutes), Mathematics (60 minutes), Reading (35 minutes), and Science Reasoning (35 minutes). The two SAT sections, SAT-verbal (60 minutes) and SAT-mathematical (60 minutes), include questions on verbal reasoning (reading and vocabulary) and mathematical reasoning (regular mathematics and quantitative comparisons).

Despite testing somewhat different content, scores on the two tests usually correlate highly. In this case it is possible to develop meaningful relationships between the two sets of scores in a *particular* population of test takers. *Standards for Educational and Psychological Testing* (1985) suggests the use of the term "comparable" rather than "equated" for scores on nonparallel tests that are scaled to achieve comparability. In the language of the *Standards*, the comparability study was intended to develop comparable scores on the ACT Composite and the SAT-V + M for a diverse group of applicants to 14 large universities.

The present report documents the procedures used in the comparability study. An important problem that had to be overcome in developing comparable scores was the amount of time that elapsed between ACT Assessment and SAT administrations. Some of the students used in the study took the ACT Assessment before the SAT, and some took the SAT before the ACT Assessment. Ideally, the sample would have taken the tests at approximately the same time. Because the time between the ACT Assessment and SAT administrations can bias the relationship between test scores, methods had to be developed to take account of this possible bias.

PREVIOUS STUDIES

Only a few SAT-ACT concordance tables or conversion equations have been published—by Chase and Barritt (1966), Pugh and Sassenrath (1968), Astin (1971), and Maxey and Lenning (1974). Several unpublished concordance tables have also been developed for use in special situations (e.g., scholarship selection) with particular populations. These were reported in Loeb and Robinson (1969), Hecht (1980), and Langston and Watkins (1980). Many other special-purpose concordance tables have been developed by state systems, universities, and other institutions but have not been reported widely.

The samples, types of conversions, and statistical methodologies used by these researchers varied considerably, as Table 1 shows. Studies differed as to the size of the sample and the range of ability represented in the sample. Astin (1971) and Langston and Watkins (1980) worked with relatively large, heterogeneous samples, but Astin did not

Table 1. ACT-SAT Score Comparability Studies*

Study	*Sample Description*	*Conversions*	*Type of Conversion*	*Statistical Procedures*
		Published Studies		
Astin (1971)	38,861 students who entered college in 1965 and took the National Merit Scholarship Qualifying Test and either the ACT Assessment or the SAT	ACT composite to SAT-V + M; SAT-V + M to ACT composite	Nonlinear	Setting scores equal that correspond to the same percentile rank on the anchor test (equipercentile through an anchor test)
Chase and Barritt (1966)	2,939 members of the 1961 freshman class at the U. of Indiana who took the Indiana University Orientation Battery and either the ACT Assessment or the SAT	ACT composite to SAT-V + M; separate conversions for men and women	Linear	Setting estimated means and standard deviations equal (estimates from anchor test based on Tucker method of equating)
Maxey and Lenning (1974)	5,479 freshmen at 10 colleges who took both the ACT Assessment and the SAT and had freshman grades; sample sizes at individual colleges ranged from 125 to 1,204	ACT composite to SAT-V + M (in ranges); separate point-by-point conversions for each of 10 colleges	Nonlinear	Setting scores equal that correspond to the same predicted freshman grade-point average
Pugh and Sassenrath (1968)	1,719 applicants to the U. of Indiana in 1964–66 who took both the ACT Assessment and the SAT; 3,557 students admitted to California state colleges in 1963 who took both the ACT Assessment and the SAT	ACT composite to SAT-V + M; separate conversions for men and women at two locations, for combined samples of men and women, and for all students	Linear	Setting means and standard deviations equal
		Unpublished Studies		
Hecht (1980)	3,729 Illinois state scholarship applicants who enrolled in Illinois colleges in the fall of 1979 and who took the ACT Assessment and the SAT a month apart	SAT-V + M to ACT composite; SAT-V + M to Illinois composite (weighted average of ACT Assessment subscores and high school rank in class)	Nonlinear	Setting scores equal that correspond to the same percentile rank (equipercentile)
Langston and Watkins (1980)	12,014 applicants to the U. of Illinois who took both the ACT Assessment and the SAT in 1978–79	ACT composite to SAT-V + M; ACT English to SAT-verbal; ACT Math to SAT-mathematical	Nonlinear	Setting scores equal that correspond to the same percentile rank (equipercentile)
Loeb and Robinson (1969)	2,682 applicants to the U. of Illinois in 1968 who took both the ACT Assessment and the SAT	ACT composite to SAT-V + M	Nonlinear	Setting scores equal that correspond to the same percentile rank (equipercentile)

*Based on information provided by Livingston (1983).

limit his sample to students at a single institution. Hecht (1980), on the other hand, studied a very select group of 2,542 Illinois State Scholarship applicants who had taken the ACT and the SAT.

Most of the researchers used data on a single group of test takers to establish score relationships. Two researchers (Astin 1971; Chase and Barritt 1966) depended on an anchor test to link ACT Assessment and SAT scores. (Students took the anchor test and either the ACT Assessment or the SAT.)

Some of the researchers used linear methods and some used nonlinear methods. Astin (1971) used the equipercentile (nonlinear) procedure with an anchor test to scale scores on the two tests. Chase and Barritt (1966) also used an anchor test but chose a linear scaling procedure (the Tucker observed score equating method). The other researchers who worked with data from a single group of students who had taken both the ACT Assessment and the SAT used different scaling methods. Pugh and Sassenrath (1968) set means and standard deviations equal (a linear procedure) to scale the scores. Maxey and Lenning (1974), on the other hand, used a procedure that set equal the ACT Composite and SAT scores that predicted the same college grade-point average. Loeb and Robinson (1969), Hecht (1980), and Langston and Watkins (1980) used the equipercentile procedure on scores from students who had taken both tests.

Hecht (1980) was the only researcher to consider explicitly the time differential between ACT and SAT test dates. He compared the two tests based on a sample of 2,542 Illinois Scholarship applicants who had taken the SAT and ACT within one month of each other. He also weighted his sample so that the number of students who took the ACT first equaled the number who took the SAT first.

The various conversion tables differ considerably in ACT-SAT score relationships because of differences in the samples used in the comparability studies and in the procedures used to develop score comparability. For example, an ACT Composite score of 30 converts to an SAT-V + M score of 1365 using Astin's conversions, but to only 1265 using Hecht's conversion. This variation is not surprising. Livingston (1983) reviewed several conversions, including those from the studies previously referenced. According to Livingston, the main reason for large differences between conversions is that the SAT and the ACT Assessment measure somewhat different intellectual skills, thus making the conversions dependent on the population of test takers and the way in which the conversion is defined.

Wainer, Holland, Swinton, and Wang (1985) reviewed three ACT-SAT comparability studies that produced score conversions for use in admission: Astin (1971), Chase and Barritt (1966), and Pugh and Sassenrath (1968). They concluded that no SAT-ACT conversion is fair to individual test takers, because individual scores depend on which test is taken. They did indicate, however, that score conversions are useful for comparing the mean scores of one group with those of another.

The tables produced by these score comparability studies have all become obsolete with the introduction of the enhanced ACT Assessment. These studies are instructive nevertheless: They remind users that ACT and SAT score relationships depend on the sample of test takers used in the comparability study. They also make it clear that the relationship between scores on these tests cannot usually be adequately described by a simple linear equation; nonlinear scaling methods are often needed. The present study was designed to take advantage of what was learned in previous comparability studies.

METHODOLOGY

Sample Description

The 14 universities participating in the study (see Table A-1 in the Appendix), members of the Association of Chief Admissions Officers of Public Universities (ACAOPU), provided social security numbers, score information, and other information from the records of applicants for admission during 1989–90. Enhanced ACT Assessment and SAT scores were obtained from the separate score files of the American College Testing Program and the College Board Admissions Testing Program by matching the social security numbers provided by the universities to the social security numbers on the score files. ACT Assessment scores came from tests administered from October 1989 to June 1990; SAT scores from tests administered from March 1989 to June 1990. The data file was screened to eliminate duplicate records and records with missing scores.

The 14 universities provided data on a combined sample of 46,851 student records for which score information was available from ACT and SAT files. When duplicate records from students who applied to two or more of these universities were eliminated, the sample size decreased to 40,492 records. The number of records per university ranged from 376 to 9,868. Two universities provided data on fewer than 1,000 applicants. Table A-2 in the Appendix provides the counts by university for the total sample and for a subsample of test takers who took the ACT Assessment and the SAT no more than 217 days apart. Both the total group and the subsample were used for the scalings conducted in this study.

Of the 40,492 students in the total sample, 50 percent identified themselves as females when they registered for the test. Approximately 61 percent declared 1990 as their year of high school graduation when they filled out the Student Descriptive Questionnaire before taking the SAT. Another 35 percent gave 1991 as their year of graduation. Approximately 2 percent gave some year other than 1990 or 1991 as their year of high school graduation, and the remaining 2 percent did not provide their year of high school graduation.

The total sample earned higher test scores on average than the group of all "college-bound" high school seniors

who took the SAT. On average the total sample scored 23.6 on the ACT Composite and 985 on the SAT-V + M, whereas college-bound seniors averaged 900 on the SAT-V + M in 1989–90 (*College Bound Seniors* 1990). In the sample the ACT composite correlated .83 with SAT-verbal, .78 with SAT-mathematical, and .89 with SAT-V + M.

Scaling Procedure

The scaling procedure used in this study was setting percentiles equal (equipercentile method). (See Angoff 1984 for a detailed description.) The equipercentile procedure can take account of nonlinear as well as linear relationships. As the name implies, the equipercentile method sets equal ACT Composite and SAT-V + M scores that have the same percentile ranks in the sample. When SAT-V + M scores are scaled to ACT Composite scores, they take on the shape of the distribution of ACT Composite scores. Likewise, ACT Composite scores scaled to SAT-V + M scores assume the shape of the SAT-V + M score distribution. Thus, the ninetieth percentile in the ACT Composite score distribution is set equal to the ninetieth percentile in the SAT-V + M distribution.

Procedures for Taking Account of the Time Difference between Testings

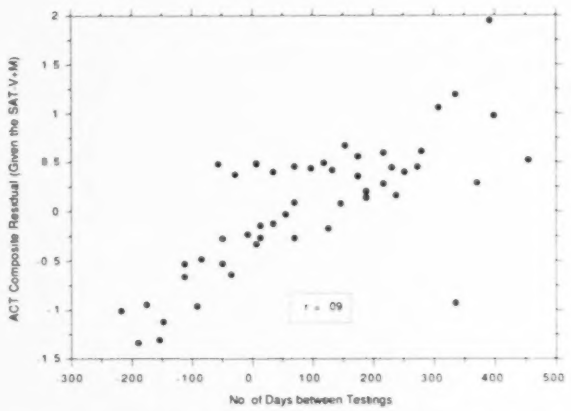
For purposes of establishing score comparability, the sample of students should take the enhanced ACT Assessment and the SAT at approximately the same time, and approximately equal numbers of students should take the ACT Assessment first and the SAT first. Students who take tests like these tend to score higher on the test they take second, particularly if they take the test several months after the first. The reason for this difference may be partly the result of growth over time in the skills tested and partly the result of familiarization with the testing situation. Whatever the reason, differences in time between testings can cause the results of a comparability study to be biased.

Table A-3 in the Appendix gives the number of test takers and descriptive statistics for each combination of ACT Assessment and SAT administration dates represented in the sample. In the table a negative number means that students took the ACT Assessment before the SAT; a positive number means that students took the SAT before the ACT Assessment. As the table shows, some students took the ACT Assessment as many as 217 days before they took the SAT; other students took the SAT as many as 455 days before they took the ACT Assessment. A total of 23,275 students took the SAT first, and 17,217 took the ACT Assessment first. On average students took the SAT 14 days before the ACT Assessment.

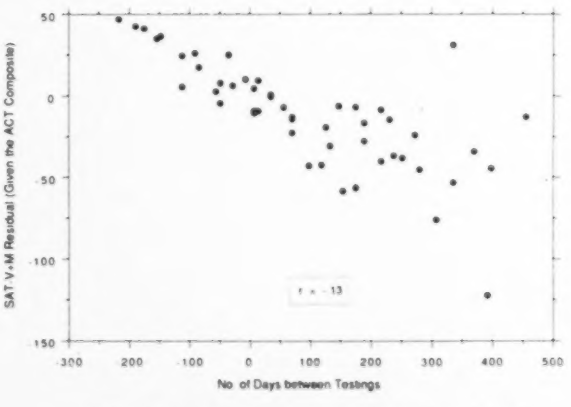
Preliminary Analysis Showing the Effect of the Time Difference

Before special procedures were used to take account of the time between testings, a preliminary analysis was conducted to determine whether the time differential affected scores enough to justify using special procedures. Differences (residuals) between actual SAT scores and estimated SAT scores were examined. The SAT scores were estimated from the ACT scores without taking account of the time differential between testing dates. ACT residuals were also examined. If these residuals were systematically related to the number of days between the time the student took the ACT and the time the student took the SAT, then the use of special procedures would be necessary to avoid any bias in developing score comparability tables.

Figure 1 shows two plots: a plot of the *mean* ACT Composite residuals given scores on the SAT-V + M against the number of days between testing dates (Fig. 1a), and a plot of the *mean* SAT-V + M residuals given scores on the ACT Composite against the number of days (Fig. 1b). On a given plot there is a point for each of the 50 groups of students who took the ACT and SAT on particular test dates (see Table A-3). A negative sign denotes that the sample took the ACT Assessment before the SAT; a positive sign



(a) ACT Composite Residuals vs. No. of Days between Testings



(b) SAT-V+M Residuals vs. No. of Days between Testings

Figure 1. Residuals (by Particular Test Dates) vs. Number of Days between Testings

denotes that they took the SAT before the ACT Assessment. Because mean residuals rather than residuals for individual test takers are plotted, the figure shows stronger relationships than plots of individual residuals would show. For the ACT Composite the correlation between the score residuals (actual versus estimated) of individual test takers and the time difference was .09; for the SAT the correlation was −.13.

These plots show that on average the sample of students who took the ACT Assessment before the SAT (negative number of days) scored lower on the ACT Composite than they would have had they taken the tests at approximately the same time (the point on the y-axis corresponding to 0 on the x-axis). They also show that on average those who took the ACT Assessment after the SAT (positive number of days) obtained ACT Composite scores that were higher than they would have been had they taken the tests at about the same time. The bias for SAT scores is in the reverse direction. The residuals vary considerably when a large number of days elapse between testings. This variation was eliminated in the subsample, which was restricted to groups that took the tests no more than 217 days apart.

To estimate more precisely the effect of the number of days between test administrations on scores, regression analyses were conducted using five variables:

1. ACT Composite scores (ACT)
2. SAT-V + M scores (V + M)
3. Number of days between ACT and SAT testings (#Days)
4. Cross-product of ACT and #Days (ACT × #Days)
5. Cross-product of SAT and #Days [(V + M) × #Days]

The regression equations included cross-product terms to allow for the possibility of an interaction between test score and number of days. For one regression analysis ACT was estimated from V + M, #Days, and (V + M) × #Days. For the other regression analysis V + M was estimated from ACT, #Days, and ACT × #Days. The results are as follows:

$$\begin{aligned} ACT &= .020531(V+M) + .0048264(\#Days) \\ &\quad - .00000187[(V+M) \times \#Days] + 3.3399 \\ V+M &= 38.8850(ACT) - .302285(\#Days) \\ &\quad + .00541668(ACT \times \#Days) + 81.8850 \end{aligned}$$

To show the effect of the number of days between testings, Table 2 was generated from these regression equations for various scores and numbers of days between testings, including 14 days, the average for the total group. The boxed numbers are the scores expected when the SAT and ACT Assessment are taken at the same time (0 days between testings). These numbers are termed the "correct estimates" because the influence of the time differential between testings is removed. The other columns in the table provide the regression estimates of test scores for different numbers of days and the deviation of these estimates from the "correct" estimates.

For tests administered 100 days apart, the results are large enough to affect many score points of a conversion

Table 2. Effect of Number of Days between Test Administrations on ACT Composite and SAT-V + M Scores

	SAT Taken 100 Days before the ACT Assessment		*SAT Taken 14 Days before the ACT Assessment*		*SAT Taken on the Same Day as the ACT Assessment*		*SAT Taken 100 Days after the ACT Assessment*	
Test Score	*Estimate*	*Deviation from "Correct" Estimate*	*Estimate*	*Deviation from "Correct" Estimate*	*"Correct" Estimate**	*Deviation from "Correct" Estimate*	*Estimate*	*Deviation from "Correct" Estimate*
				Criterion: ACT Composite Score				
SAT-V + M:								
1600	36.37	.18	36.22	.03	36.19	.00	36.01	−.18
1400	32.30	.22	32.11	.03	32.08	.00	31.86	−.22
1200	28.24	.26	28.01	.04	27.98	.00	27.72	−.26
1000	24.17	.30	23.91	.04	23.87	.00	23.58	−.30
800	20.10	.33	19.81	.05	19.76	.00	19.43	−.33
600	16.03	.37	15.71	.05	15.66	.00	15.29	−.37
400	11.96	.41	11.61	.06	11.55	.00	11.14	−.41
Mean (= 985.2)	23.87	.30	23.61	.04	23.57	.00	23.27	−.30
				Criterion: SAT-V + M Score				
ACT Composite:								
36	1452.3	−10.7	1461.5	−1.5	1463.0	0.0	1473.7	10.7
30	1218.8	−14.0	1230.9	−2.0	1232.8	0.0	1246.8	14.0
24	985.4	−17.2	1000.2	−2.4	1002.6	0.0	1019.9	17.2
18	752.0	−20.5	769.6	−2.9	772.4	0.0	792.9	20.5
12	518.5	−23.7	538.9	−3.3	542.3	0.0	566.0	23.7
6	285.1	−27.0	308.3	−3.8	312.1	0.0	339.1	27.0
Mean (= 23.61)	970.2	−17.4	985.2	−2.4	987.7	0.0	1005.1	17.4

*Estimate with the effect of number of days between test administrations removed.

table. Score comparability tables could be off by nearly half a point on the ACT Composite scale and by approximately 30 points on the SAT-V + M scale. On the other hand, the average deviation from the correct estimate is relatively small (see the entry in Table 2 at the mean for 14 days). The ACT Composite scores are on average .04 too high, and the SAT-V + M scores are 2.4 points too low relative to where they should be (the "correct" estimates). The deviations get larger in absolute value as the score scale goes from high to low, but are still relatively small at their maximum absolute value (.06 for the ACT Composite and −3.8 for the SAT-V + M). Still, some score points in a conversion table could be affected by deviations this small. Some ACT Composite converted scores would be 1 point higher and some SAT-V + M scores 10 points lower than they would be if they were based on tests administered at approximately the same time.

Subsampling on the Number of Days between Testings

The first step taken to account for the possible bias due to the difference in number of days between testing dates was subsampling. Because ACT introduced the enhanced ACT Assessment in October 1989, it was impossible for a student tested between October 1989 and June 1990 to take the ACT Assessment more than 217 days before the SAT. Therefore, as a first step toward eliminating possible bias, students who took the tests more than 217 days apart were excluded from the sample for a number of the analyses (see Table A-2 in the Appendix). This step eliminated the March 1989 SAT test takers from the sample and reduced the sample to 40,051 students. In this subsample, however, only 17,217 students took the ACT Assessment first, whereas 22,834 took the SAT first. On average, the students in the subsample took the SAT approximately 11 days earlier than the ACT Assessment.

Comparing Score Conversions on ACT-First and SAT-First Samples

To help decide whether additional steps needed to be taken to take account of the time between testings, preliminary ACT-to-SAT and SAT-to-ACT concordance tables were developed for the sample that took the SAT first (N = 22,834) and the sample that took the ACT first (N = 17,217). (The subsample that took the tests no more than 217 days apart provided the scores for this analysis.) The equipercentile procedure, described later, was used to scale the scores. Negligible score differences between the two ACT-to-SAT and SAT-to-ACT tables would indicate that the effect of time was not large enough to require additional score adjustments.

Tables A-4 and A-5 in the Appendix give the unrounded score conversions for the two subsamples. Table A-4 shows differences in ACT-to-SAT conversions as high as 35 points at the high end of the score scale and 27 points in the middle. Most of the differences ranged between 15 and 25 points. Except at the ends of the score scale, the ACT-to-SAT score conversions for the sample that took the SAT first yielded lower SAT scores than the conversions for the sample that took the ACT first—as might be expected if a bias existed. Differences in SAT-to-ACT conversions were as large as 2.5 points (at the low end of the scale). Typically, score conversions differed by about .5 of a score point. Such differences exceed the effects of rounding and are large enough to affect many points in the score conversion tables. Thus, the authors decided to use more complicated procedures to adjust scores.

Weighting

Regression procedures like those used to estimate the effects of time for the total group could have been used to provide a further adjustment for the time differential between testings in the subsample. These procedures were not used because they result in linear adjustments, when nonlinear adjustments may be more appropriate. Also, they provide the same adjustment for all students at a given score level who were tested a particular number of days apart, and thus do not preserve the variation inherent in the original scores. Instead a weighting system was used that does not have these limitations. This weighting system weighted the scores of those students who took the ACT first more heavily than the scores of those who took the SAT first. The simplest system, used by Hecht (1980), is to count each student who took the ACT Assessment first equal to 1.326 (i.e., 22,834/17,217) students who took the SAT first. This adjustment, however, disregards the length of time between the two test administrations. In the present study students were weighted so as to make the average number of days between testings equal to zero for the combined group (those who took the ACT first plus those who took the SAT first).

Table 3 gives the distributions of the number of days between test administrations for those students who took the ACT first and those who took the SAT first. It also shows the weights that were applied and the weighted frequency that resulted. These particular weights were chosen to accomplish the desired result but keep the weights relatively small and affect only a relatively small number of scores.

As is evident from Table 3, three weights (other than 1.00000) were used, depending on the number of days the ACT was taken before the SAT: 1.00049 for students who took the tests 7 days apart, 1.38216 for students who took the tests 28 to 112 days apart, and 4.88503 for students who took the tests 147 or more days apart. For computing the weights, each of these three groups of students who took the ACT first was matched with a group of students who took the SAT the same or a similar number of days before the ACT Assessment. Thus, the group that took the ACT Assessment 7 days before the SAT was matched with the group that took the SAT 7 days before the ACT Assessment. Likewise, the groups that took the ACT Assessment 147, 154, 175, 189, or 217 days before the SAT were matched with the groups that took the SAT these same numbers of days before the ACT Assessment. The remaining group—those who took the ACT Assessment 28, 35, 49, 56, 84, 91, or 112 days before the SAT—was matched with the group that

Table 3. Distributions of Number of Days between Testings for Total Sample and Selected Sample

*No. of Days Between Testings**	*Total Sample*	*Sample Selected on No. of Days Between Testings*		
	Frequency	*Frequency*	*Weighted Frequency*	*Weight*
ACT First:				
−217	49	49	239.4	4.88503
−189	68	68	332.2	4.88503
−175	64	64	312.6	4.88503
−154	178	178	869.5	4.88503
−147	80	80	390.8	4.88503
−112	352	352	486.5	1.38216
−91	949	949	1311.7	1.38216
−84	172	172	237.7	1.38216
−56	1341	1341	1853.5	1.38216
−49	1509	1509	2085.7	1.38216
−35	1620	1620	2239.1	1.38216
−28	2700	2700	3731.8	1.38216
−7	8135	8135	8139.0	1.00049
SAT First:				
7	8139	8139	8139.0	1.00000
14	3519	3519	3519.0	1.00000
35	4470	4470	4470.0	1.00000
56	997	997	997.0	1.00000
70	2018	2018	2018.0	1.00000
98	727	727	727.0	1.00000
119	384	384	384.0	1.00000
126	226	226	226.0	1.00000
133	259	259	259.0	1.00000
147	615	615	615.0	1.00000
154	265	265	265.0	1.00000
175	578	578	578.0	1.00000
189	350	350	350.0	1.00000
217	287	287	287.0	1.00000
231	117			
238	49			
252	84			
273	47			
280	47			
308	31			
336	36			
371	11			
392	5			
399	9			
455	5			
No. of Cases	40,492	40,051	45,063.5	
Mean	14.0	11.2	0.0	
Std. Dev.	64.3	58.5	66.7	

*ACT Julian date minus SAT Julian date.

took the SAT 14, 35, 56, 70, 98, 119, 126, or 133 days before the ACT Assessment.

The weight for *each* pair of matched groups was computed as follows:

$$\frac{\Sigma f_j|n_j|}{\Sigma f_k|n_k|},$$

where $f_j|n_j|$ is the cross-product of the frequency in number-of-day category j and the absolute value of the number of days between testing in category j for the group that took the SAT first, $f_k|n_k|$ is the cross-product of the frequency in category k and the absolute value of the number of days between testings in category k for the matched group that took the ACT first, and Σ refers to the summation across the various number-of-day categories represented in the matched group. In words, the weight for a given pair of matched groups was computed by dividing the number of days between test dates summed across all individuals who took the SAT first by the number of days between testings summed across all individuals who took the ACT first. The weight 4.88503, for example, was computed as follows:

$$\frac{[(615 \times 147) + (265 \times 154) + \ldots + (287 \times 217)]}{[(80 \times 147) + (178 \times 154) + \ldots + (49 \times 217)]}$$

Applying the weights given in Table 3 reduced the mean difference in test dates in the subsample from 11.2 days to zero (see the summary statistics in Table 3).

Smoothing Procedures

A problem with the equipercentile method is that in the score locations where the data are sparse, usually at the extremes of the score scales, the percentile ranks observed in one sample can vary considerably from those that would be observed in another sample (or in the full population, if that were possible). The solution to this problem is to "smooth" the score distributions to remove any irregularities and thus produce "smoothed" distributions that are more like the distributions that would be observed with repeated sampling.

Before scaling, two sets of ACT Composite and SAT-V + M score distributions were smoothed by using log-linear procedures implemented by Holland and Thayer (1987). These two sets of distributions were the score distributions for the total sample and the weighted score distributions for the subsample. Both univariate and bivariate smoothing were used in the study. The univariate procedure preserves the first five moments (expected values of ΣX, ΣX^2, ΣX^3, ΣX^4, and ΣX^5) of each score distribution. The bivariate procedure preserves these moments plus four additional cross-product moments (expected values of ΣX_1X_2, $\Sigma X_1^2X_2$, $\Sigma X_1X_2^2$, and $\Sigma X_1^2X_2^2$). The bivariate procedure, the preferable procedure to use when data on two variables come from a single sample, was used to smooth the score distributions from the total sample of 40,492 cases. Because only the ACT Composite and SAT-V + M univariate score distributions were weighted, bivariate smoothing could not be applied to these distributions, which were available from the 40,051-case subsample that took the ACT Assessment and the SAT no more than 217 days apart. Univariate smoothing was used instead. For both bivariate and univariate smoothing, score frequencies were smoothed over the observed score ranges, not the possible ranges. Thus, no score frequencies were estimated for score levels beyond the observed score ranges.

Table 4 shows three ACT Composite and three SAT-V + M score distributions: the unweighted distributions, the weighted distributions, and the weighted and smoothed distributions. Thus, the table shows how weighting and smoothing affected the score distributions. The table shows that the smoothing procedure preserved the means and standard deviations of the weighted score distributions. It also shows the value of smoothing in the tails of the distributions, where data are sparse. The results of smoothing are perhaps more evident in Figure A-1 in the Appendix, which shows the same three distributions. (For comparison purposes, the weighted distributions were standardized to have the same overall sample count as the unweighted distributions.) The effectiveness of the smoothing procedure is perhaps most noticeable in Figure A-1b, which shows the jaggedness of the unsmoothed SAT-V + M distribution compared with the smooth fit provided by the log-linear procedure.

Score Distributions Used in Scaling

The total sample ACT Composite and SAT-V + M score distributions ordinarily would be the ones used in a scaling study. The total sample score distributions represent a weighted sum of the score distributions from the separate universities. In this study, however, there was a concern about the possible impact on scores of the amount of time that elapsed between ACT Assessment and SAT test dates. Thus, in addition to total sample score distributions, score distributions of a subsample selected on the basis of the number of days between ACT and SAT administrations were used. Within this subsample, score distributions of those who took the SAT first and of those who took the ACT first were also used for scaling.

The various ACT Composite and SAT-V + M score distributions used in the study for scaling purposes were as follows:

1. *Total sample distributions (based on 40,492 test takers):*
   - Unweighted
   - Smoothed (bivariate) unweighted
2. *Subsample distributions (based on 40,051 test takers):*
   - Unweighted
   - Weighted
   - Smoothed (univariate) weighted

The unweighted score distributions were the actual score distributions obtained from the samples; the weighted distributions were those for which the weighting procedure described earlier was applied. The smoothed distributions were those for which the smoothing procedure, also described earlier, was applied. The smoothing procedure could be used with either an unweighted or a weighted distribution, but the type of smoothing depended on whether the score distribution was weighted or unweighted. Bivariate smoothing was used with unweighted distributions. Because of the complexity of preparing the data for bivariate smoothing, univariate smoothing (smoothing only the ACT Assessment and SAT-V + M marginal distributions) was used with weighted distributions.

These procedures were applied to only selected distributions—those that were most likely to determine the conversion recommended for operational use. As indicated earlier in the report, weighting was one of the procedures used to account for differences in time of testing, and thus was applied only on the subsample selected on the basis of the number of days between testings. Smoothing, on the other hand, was used with both the total and the subsample weighted score distributions.

Table 4. ACT Composite and SAT-V + M Score Distributions

ACT Composite Score	*Frequency*	*Weighted Frequency*	*Smoothed Weighted Frequency*	*SAT-V + M Score*	*Frequency*	*Weighted Frequency*	*Smoothed Weighted Frequency*
36	4	4.8	22.1				
35	58	64.1	79.9				
34	203	232.4	216.0				
33	451	521.5	462.8				
32	748	856.5	823.6				
31	1079	1231.0	1267.4				
30	1538	1748.8	1744.1	1550-1590	5	5.4	21.7
29	1979	2227.1	2205.7	1500-1540	50	65.0	64.0
28	2221	2470.2	2619.1	1450-1490	163	184.4	161.5
27	2595	2862.6	2967.4	1400-1440	301	353.6	353.8
26	3046	3383.5	3244.6	1350-1390	597	708.8	679.8
25	3154	3478.1	3447.6	1300-1340	1012	1172.2	1159.1
24	3225	3580.9	3571.0	1250-1290	1577	1812.9	1774.7
23	3251	3607.3	3604.4	1200-1240	2117	2366.1	2467.9
22	3225	3570.0	3533.6	1150-1190	2726	3061.9	3151.9
21	3061	3444.4	3345.6	1100-1140	3328	3724.6	3735.1
20	2688	3038.4	3035.6	1050-1090	3742	4197.5	4144.3
19	2257	2532.5	2615.5	1000-1040	4052	4499.0	4338.2
18	1798	2058.0	2118.2	950-990	3810	4275.4	4309.4
17	1334	1558.4	1595.1	900-940	3728	4158.0	4077.0
16	863	1031.3	1104.8	850-890	3175	3541.6	3677.9
15	618	757.4	696.6	800-840	2842	3178.0	3158.6
14	382	479.7	396.0	750-790	2207	2475.6	2570.2
13	166	201.9	201.3	700-740	1736	1977.2	1965.5
12	76	81.4	90.9	650-690	1228	1401.9	1395.9
11	24	34.1	36.3	600-640	821	944.0	906.1
10	5	5.4	12.8	550-590	482	560.7	526.9
9	1	1.0	4.0	500-540	232	258.5	267.7
8	0	0.0	1.1	450-490	97	112.4	115.4
7	1	1.0	0.3	400-440	23	28.8	40.8
No. of Cases	40,051	45,063.5	45,063.5	No. of Cases	40,051	45,063.5	45,063.5
Mean	23.62	23.57	23.57	Mean	986.0	986.4	986.4
Std. Dev.	4.45	4.50	4.50	Std. Dev.	193.1	194.5	194.5
Min. Score	7	7	7	Min. Score	400	400	400
Max. Score	36	36	36	Max. Score	1590	1590	1590

RESULTS: SCORE CONVERSIONS

Recommended Score Conversion Table

The conversion table recommended for operational use, Table 5, gives the smoothed weighted subsample equipercentile results for the subsample selected on the basis of the number of days between testing dates. Table 5 is divided into two parts: one for converting SAT scores to ACT scores and one for converting ACT scores to SAT scores. Table A-6 in the Appendix gives the SAT-V + M scores corresponding to ACT Composite scores, and Table A-7 in the Appendix shows the ACT Composite to SAT-V + M conversions for all five types of score distributions identified earlier. These two tables express the converted scores to one more significant digit than required for reported scores, so that the change in conversions from score to score is noticeable.

As Table 5 shows, generally more than one SAT-V + M score converts to a particular ACT composite score, whereas in general only one ACT Composite score converts to a particular SAT-V + M score. These many-to-one and one-to-one conversions occur because the SAT-V + M scale has 121 score points, whereas the ACT Composite scale has only 36. Conversion data did not exist for an ACT Composite score below 7, nor for an SAT-V + M score of 1600. Therefore, ACT scores below 7 were set equal to 400—the SAT-V + M score corresponding to 7—and an SAT-V + M score of 1600 was set equal to 36—the ACT Composite score corresponding to 1590.

The smoothed weighted subsample equipercentile conversions are recommended for operational use because (1) smoothing reduced the irregularities in the conversion lines at the extremes of the scale and (2) weighting and subsampling adjusted at least to some extent for the different time intervals between testings.

Table 5. SAT-ACT Concordance Table

SAT to ACT		*ACT to SAT*	
SAT-V + M Score	*ACT Composite Score*	*ACT Composite Score*	*SAT-V + M Score*
1550-1600	36	36	1560
1490-1540	35	35	1510
1440-1480	34	34	1450
1380-1430	33	33	1400
1330-1370	32	32	1350
1290-1320	31	31	1300
1240-1280	30	30	1260
1200-1230	29	29	1210
1160-1190	28	28	1170
1110-1150	27	27	1130
1070-1100	26	26	1090
1030-1060	25	25	1050
990-1020	24	24	1010
950-980	23	23	970
910-940	22	22	920
860-900	21	21	880
820-850	20	20	840
770-810	19	19	790
720-760	18	18	740
680-710	17	17	700
630-670	16	16	650
580-620	15	15	600
540-570	14	14	560
500-530	13	13	520
460-490	12	12	480
430-450	11	11	440
410-420	10	10	420
400	9	1-9	400

Note: This table was developed by the College Board and Educational Testing Service from 1989 and 1990 ACT Assessment and SAT data. It was prepared at the request of the Association of Chief Admissions Officers of Public Universities and was supported by funds from the College Board. This table may be reproduced for use by colleges and other institutions. This table is based on data from 40,051 students who took the enhanced ACT Assessment between October 1989 and June 1990 and the SAT between May 1989 and June 1990 and had scores sent to the 14 participating universities.

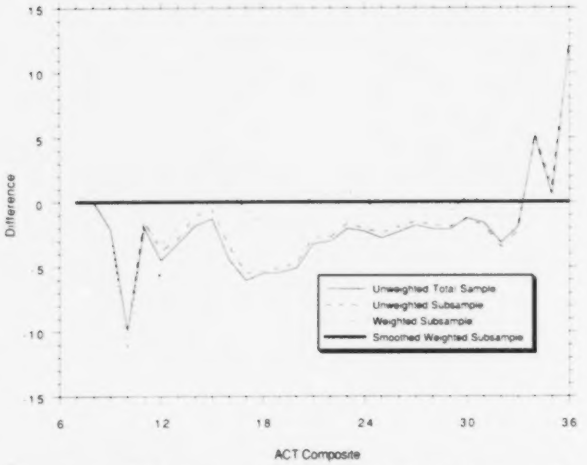


Figure 2. Differences in ACT-to-SAT Equipercentile Scalings: Effects of Subsampling, Weighting, and Smoothing

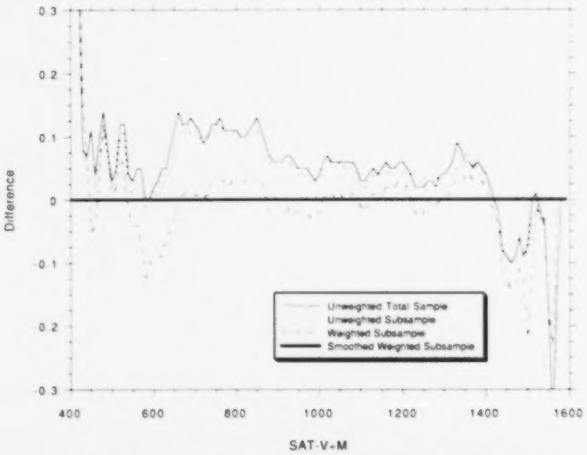


Figure 3. Differences in SAT-to-ACT Equipercentile Scalings: Effects of Subsampling, Weighting, and Smoothing

Effects of Subsampling, Smoothing, and Weighting

Figures 2 and 3 show the effects of subsampling, weighting, and smoothing on converted scores. Because it is difficult to compare conversions directly, the differences in converted scores were plotted for particular scalings. In *each* plot the differences shown are those computed by subtracting the subsample equipercentile conversions resulting from the smoothed weighted score distributions (the "criterion scaling results") from conversion results for each of the other scalings represented in the plot. The smoothed weighted equipercentile conversions for the subsample were selected as the criterion in the plots because they are the conversions recommended for operational use.

The results obtained by scaling the scores on the subsample (unweighted subsample line) were similar to those obtained on the total sample (unweighted total sample line). On the other hand, weighting the scores made a difference except at the extremes of the score ranges, where the weighted results were similar to the unweighted results. Smoothing not only helped reduce minor aberrations in the weighted subsample lines but also took care of some of the jaggedness in the conversions at extremes of the score scales. It is clear from the figure that weighting the subsample had the effect of correcting the score conversions in the right directions: reducing slightly the ACT scores corresponding to SAT scores and increasing slightly the SAT scores corresponding to ACT scores. (The reader should recall that on average the ACT was administered approximately 14 days after the SAT.) Smoothing, interestingly

enough, had a larger effect on the results than subsampling—calling attention to the importance of using a good unbiased smoothing method.

Figure 4 provides additional information on how smoothing the score distributions affected the scaling results. Results are shown for both the total sample and the weighted subsample. The data plotted are the slopes of the conversion lines—changes in converted scores corresponding to a change of one point in the ACT Composite score or a change of 10 points in the SAT-V + M score.

For both the total sample and the weighted subsample, smoothing reduced the irregularities in the slopes. As might be expected from an unbiased procedure, the smoothed line goes through the middle of the unsmoothed results for each sample. The effect of smoothing was the most marked for the ACT-to-SAT conversions, particularly at the extremes of the score scale, where data were relatively sparse. Smoothing reduced the irregularities in the SAT-to-ACT conversions only slightly presumably because the ACT scale has fewer scores than the SAT scale. In general, smoothing resulted in small corrections—no more than .3 of a score point on the ACT scale and 12 score points on the SAT-V + M scale. Such corrections are large enough, however, to make a difference in the score conversions for a considerable number of score points when rounded to two digits on the ACT scale or three digits (including a trailing 0) on the SAT-V + M scale.

METHODOLOGICAL STRENGTHS OF THE STUDY

In the comparability study designed to produce new concordance tables between scores on the SAT and scores on the enhanced ACT Assessment (Marco and Abdel-fattah 1991), methodology was developed to take account of the time difference between first and second testings. This report described the methods used in the study and provided details not available in the earlier report.

Several steps were taken in selecting the scaling sample and analyzing the data to ensure that the scaling results were not contaminated by extraneous factors:

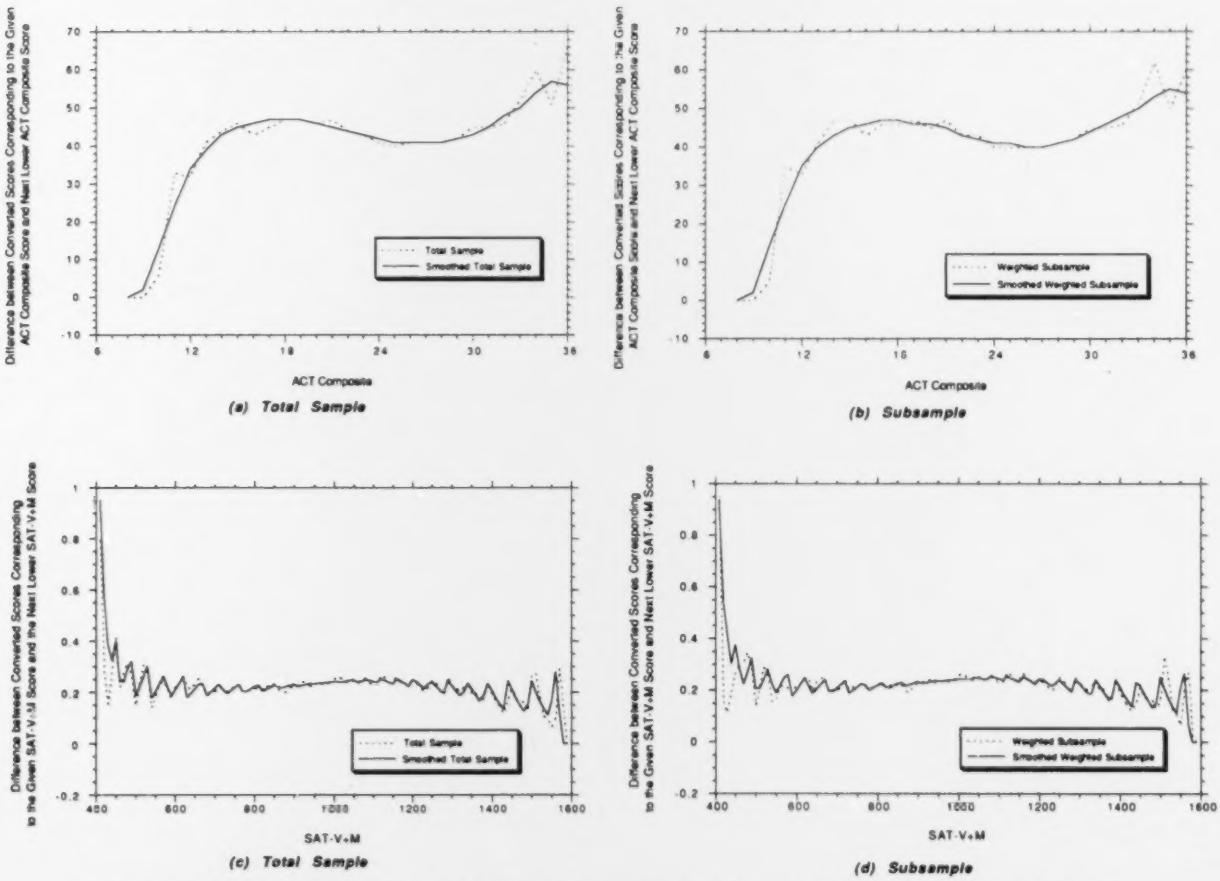

Difference between Converted Scores Corresponding to the Given ACT Composite Score and Next Lower ACT Composite Score
ACT Composite
Total Sample
Smoothed Total Sample
(a) Total Sample
Weighted Subsample
Smoothed Weighted Subsample
(b) Subsample
Difference between Converted Scores Corresponding to the Given SAT-V+M Score and the Next Lower SAT-V+M Score
SAT-V+M
(c) Total Sample
(d) Subsample

Figure 4. Differences in Converted Scores Corresponding to Adjacent ACT Composite or SAT-V + M Scores

1. The sample was limited to those students who took the ACT Assessment and the SAT within a reasonable time period. For the total sample the scores came from five ACT administrations (October 1989–June 1990) and ten SAT administrations (March 1989–June 1990). Scores from ACT administrations before October 1989 could not be used, for the enhanced ACT Assessment was not introduced until the fall of 1989. Because some of these students took the SAT over a year before the ACT, a more restricted subsample—those who took the tests no more than 217 days apart—was also used in scaling the scores.
2. Account was taken of the time between ACT and SAT administrations by weighting the test scores. This step was necessary because even in the subsample many more students took the SAT first (N = 22,834) than took the ACT Assessment first (N = 17,217). The weighting procedure gave the most weight to scores based on students who took the ACT Assessment 112 to 217 days before the SAT. It thus "equalized" the different sample sizes by reducing the average number of days between testings to zero.
3. Score distributions were smoothed before scaling. The log-linear smoothing method used here (Holland and Thayer 1987) is a complicated statistical procedure that provides good fits to various types of score distributions. As used in this study, the procedure preserved the first five moments of the ACT Composite and SAT-V + M score distributions.

The authors do not claim that the methodological improvements introduced in this study are superior to other methodologies that might have been used. Nevertheless, the procedures may prove useful to those who want to develop meaningful score relationships on tests given to the same students but at different times.

Although this study avoided some methodological shortcomings of previous ACT-SAT comparability studies, it is important to point out that no statistical methodology can adequately adjust for differences in scores that result from tests that cover different content. Because the ACT Assessment and the SAT are not parallel in content, some ACT test takers would perform better or worse on the SAT than their ACT Assessment scores would imply. Similarly, some SAT takers would perform better or worse on the ACT Assessment than their SAT scores would imply. Moreover, the score relationships reported in the comparability study would not necessarily have been the same had a different sample of test takers been used.

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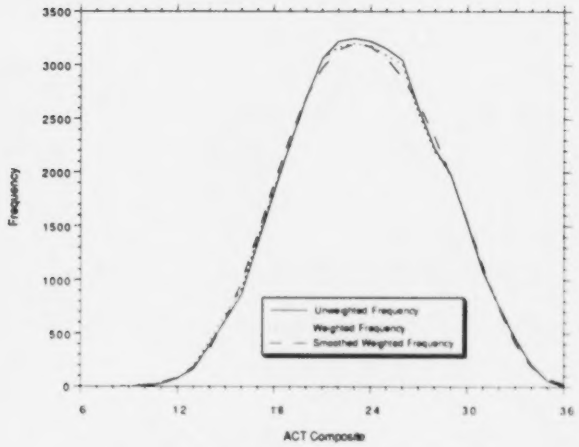
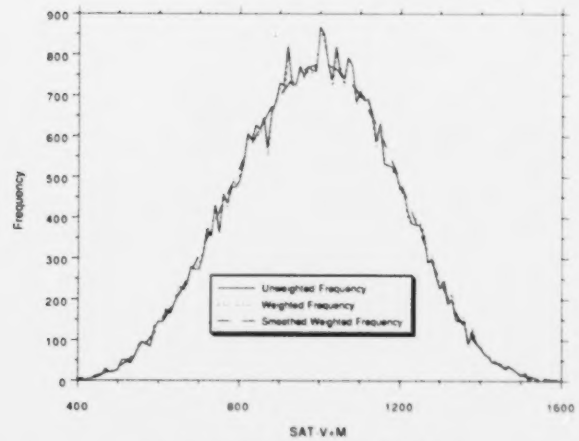
APPENDIX: Statistics



(a) ACT Composite Distributions (N=40,051)



(b) SAT-V+M Distributions (N=40,051)

Figure A-1. Unweighted, Weighted, and Smoothed Weighted Score Distributions

Table A-1. Universities That Provided Applicant Information

Name	*Location*
Alabama, University of	Tuscaloosa, Alabama
Arizona, University of	Tucson, Arizona
Arizona State University	Tempe, Arizona
Ball State University	Muncie, Indiana
California, University of	Berkeley, California
Colorado, University of	Boulder, Colorado
Illinois, University of	Urbana, Illinois
Iowa State University	Ames, Iowa
Michigan, University of	Ann Arbor, Michigan
Michigan State University	East Lansing, Michigan
Texas, University of	Austin, Texas
Texas A&M University	College Station, Texas
Washington, University of	Seattle, Washington
West Virginia University	Morgantown, West Virginia

Table A-2. Number of Records with ACT and SAT Scores

*University**	*No. of Records*	*No. of Records after Subsampling on No. of Days between Testings***
A	1,473	1,471
B	3,380	3,212
C	1,570	1,566
D	5,622	5,615
E	9,868	9,851
F	3,676	3,667
G	4,516	4,508
H	1,155	1,154
I	2,262	2,256
J	843	823
K	2,045	2,034
L	3,077	2,949
M	376	374
N	6,988	6,909
Total	46,851	46,389
Total (no duplicate social security nos.)	40,492	40,051

*Universities are not identified by name to protect their anonymity.
**Includes those records for which the ACT and SAT test dates were no more than 217 days apart.

TABLE A-3. Descriptive Statistics on Samples That Took the ACT and SAT on Particular Test Dates

SAT Test Date	ACT Test Date	No. of Days between Testings*	No. of Test Takers	ACT Composite		SAT-V + M	
				Mean	Std. Deviation	Mean	Std. Deviation
11-Mar-89	28-Oct-89	231	117	24.24	4.62	994.4	226.7
	9-Dec-89	273	47	23.38	4.39	952.1	155.2
	10-Feb-90	336	25	24.04	4.30	948.0	179.6
	7-Apr-90	392	5	21.00	3.69	762.0	173.6
	9-Jun-90	455	5	24.80	2.86	1018.0	141.8
6-May-89	28-Oct-89	175	470	24.58	4.25	1015.3	196.1
	9-Dec-89	217	165	24.06	4.16	993.4	183.4
	10-Feb-90	280	47	22.09	4.22	880.6	192.4
	7-Apr-90	336	11	22.18	4.30	960.9	135.0
	9-Jun-90	399	9	23.89	5.72	951.1	265.7
3-Jun-89	28-Oct-89	147	615	23.35	4.57	968.4	199.4
	9-Dec-89	189	236	22.61	4.89	929.7	213.1
	10-Feb-90	252	84	21.76	4.19	875.2	183.4
	7-Apr-90	308	31	21.26	4.34	818.1	206.6
	9-Jun-90	371	11	21.64	5.19	874.5	233.5
14-Oct-89	28-Oct-89	14	2442	23.79	4.01	1001.2	165.4
	9-Dec-89	56	997	22.75	4.06	944.8	176.0
	10-Feb-90	119	384	21.80	3.71	872.6	160.7
	7-Apr-90	175	108	20.77	3.82	818.7	152.5
	9-Jun-90	238	49	20.78	4.05	838.6	166.2
4-Nov-89	28-Oct-89	− 7	8135	23.44	4.07	988.6	183.0
	9-Dec-89	35	1916	22.93	4.30	958.3	185.0
	10-Feb-90	98	727	21.50	3.93	860.5	178.8
	7-Apr-90	154	265	21.10	4.75	829.4	206.9
	9-Jun-90	217	122	22.51	4.20	902.1	193.4
2-Dec-89	28-Oct-89	− 35	1620	22.96	4.13	984.9	183.7
	9-Dec-89	7	2425	22.46	4.03	945.1	172.3
	10-Feb-90	70	601	21.04	4.01	872.8	178.2
	7-Apr-90	126	226	20.90	4.62	861.2	189.6
	9-Jun-90	189	114	21.83	4.73	888.3	212.3
27-Jan-90	28-Oct-89	− 91	949	21.57	3.87	932.3	175.0
	9-Dec-89	− 49	995	21.85	4.12	925.0	179.9
	10-Feb-90	14	1077	21.42	4.15	891.4	177.1
	7-Apr-90	70	416	21.82	5.14	893.2	226.4
	9-Jun-90	133	259	22.57	5.09	913.7	222.1
31-Mar-90	28-Oct-89	−154	178	20.79	4.26	911.1	191.0
	9-Dec-89	−112	214	21.00	4.99	889.7	211.6
	10-Feb-90	− 49	514	21.84	4.73	912.3	206.9
	7-Apr-90	7	2128	24.82	4.61	1020.8	195.2
	9-Jun-90	70	1001	24.35	4.33	999.2	188.7
5-May-90	28-Oct-89	−189	68	21.38	4.77	941.6	212.6
	9-Dec-89	−147	80	21.80	5.07	951.5	205.1
	10-Feb-90	− 84	172	22.96	4.84	977.2	210.3
	7-Apr-90	− 28	2700	25.92	4.44	1080.0	189.2
	9-Jun-90	35	2554	25.49	3.98	1058.0	169.7
2-Jun-90	28-Oct-89	−217	49	23.33	5.20	1020.8	217.3
	9-Dec-89	−175	64	23.08	5.05	1005.6	224.4
	10-Feb-90	−112	138	23.41	5.41	1001.7	227.3
	7-Apr-90	− 56	1341	26.06	4.21	1081.8	189.6
	9-Jun-90	7	3586	24.96	4.16	1027.7	186.6

*Computed by subtracting the SAT Julian date from the ACT Julian date. A negative number resulted whenever the SAT test date came after the ACT test date.

Table A-4. SAT-V + M Scores (Unrounded) Corresponding to ACT Composite Scores: SAT-First and ACT-First Samples

ACT Composite Score	*Unweighted (SAT First; N = 22,834)*	*Unweighted (ACT First; N = 17,217)*	*Difference* (ACT First Minus SAT First)*
36	1585	1550	−35
35	1505	1518	13
34	1456	1463	8
33	1397	1400	3
32	1342	1351	9
31	1293	1308	16
30	1248	1264	16
29	1203	1221	18
28	1161	1179	18
27	1120	1139	19
26	1077	1101	24
25	1036	1062	27
24	997	1020	24
23	955	979	24
22	915	934	20
21	870	889	19
20	826	841	14
19	780	794	14
18	735	746	11
17	686	701	15
16	641	655	14
15	600	612	11
14	556	563	6
13	513	516	3
12	476	468	−7
11	445	435	−10
10	415	400	−15
9	403		
8	400		
7	400		
6			
5			
4			
3			
2			
1			

*The differences were calculated from scores expressed to greater precision than the table shows and then rounded off. Thus, the differences may not equal the differences calculated from the tabled numbers.

Table A-5. ACT Composite Scores (Unrounded) Corresponding to SAT-V + M Scores: SAT-First and ACT-First Samples

SAT-V + M Score	*Unweighted (SAT First; N = 22,834)*	*Unweighted (ACT First; N = 17,217)*	*Difference* (ACT First Minus SAT First)*
1600			
1590	36.0		
1580	35.8		
1570	35.5		
1560	35.5	36.0	.5
1550	35.5	36.0	.5
1540	35.4	35.7	.3
1530	35.3	35.3	.0
1520	35.3	35.1	−.2
1510	35.1	34.8	−.4
1500	34.9	34.5	−.4
1490	34.6	34.4	−.2
1480	34.4	34.3	−.1
1470	34.2	34.1	−.1
1460	34.1	34.0	−.1
1450	33.9	33.8	.0
1440	33.6	33.6	.0
1430	33.5	33.4	.0
1420	33.4	33.3	−.1
1410	33.2	33.2	−.1
1400	33.1	33.0	−.1
1390	32.8	32.8	.0
1380	32.6	32.6	.0
1370	32.5	32.4	−.1
1360	32.3	32.2	−.1
1350	32.1	32.0	−.2
1340	32.0	31.8	−.2
1330	31.7	31.5	−.3
1320	31.5	31.3	−.2
1310	31.3	31.0	−.3
1300	31.1	30.8	−.4
1290	30.9	30.5	−.4
1280	30.7	30.3	−.4
1270	30.5	30.1	−.3
1260	30.3	29.9	−.4
1250	30.0	29.6	−.4
1240	29.8	29.4	−.4
1230	29.6	29.2	−.4
1220	29.4	29.0	−.4
1210	29.2	28.7	−.4
1200	28.9	28.5	−.4
1190	28.7	28.3	−.4
1180	28.4	28.0	−.4
1170	28.2	27.8	−.4
1160	28.0	27.5	−.4
1150	27.7	27.3	−.4
1140	27.5	27.0	−.4
1130	27.2	26.8	−.5
1120	27.0	26.5	−.5
1110	26.8	26.2	−.5
1100	26.5	26.0	−.5
1090	26.3	25.7	−.6
1080	26.1	25.5	−.6
1070	25.8	25.2	−.6
1060	25.6	24.9	−.7
1050	25.4	24.7	−.7
1040	25.1	24.5	−.7

Table A-5. (Continued)

SAT-V + M Score	*Unweighted (SAT First; N = 22,834)*	*Unweighted (ACT First; N = 17,217)*	*Difference* (ACT First Minus SAT First)*
1030	24.9	24.2	−.6
1020	24.6	24.0	−.6
1010	24.4	23.7	−.6
1000	24.1	23.5	−.6
990	23.8	23.2	−.6
980	23.6	23.0	−.6
970	23.4	22.8	−.6
960	23.1	22.6	−.5
950	22.9	22.3	−.5
940	22.6	22.1	−.5
930	22.4	21.9	−.5
920	22.1	21.7	−.5
910	21.9	21.5	−.4
900	21.7	21.2	−.4
890	21.4	21.0	−.4
880	21.2	20.8	−.4
870	21.0	20.6	−.4
860	20.8	20.4	−.4
850	20.6	20.2	−.4
840	20.3	20.0	−.3
830	20.1	19.8	−.3
820	19.9	19.6	−.3
810	19.6	19.4	−.3
800	19.4	19.1	−.3
790	19.2	18.9	−.3
780	19.0	18.7	−.3
770	18.8	18.5	−.3
760	18.6	18.3	−.3
750	18.4	18.1	−.3
740	18.1	17.9	−.3
730	17.9	17.7	−.2
720	17.7	17.5	−.2
710	17.5	17.2	−.3
700	17.3	17.0	−.3

Table A-5. (Continued)

SAT-V + M Score	*Unweighted (SAT First; N = 22,834)*	*Unweighted (ACT First; N = 17,217)*	*Difference* (ACT First Minus SAT First)*
690	17.1	16.8	−.3
680	16.9	16.6	−.3
670	16.7	16.4	−.3
660	16.5	16.1	−.3
650	16.2	15.9	−.3
640	16.0	15.6	−.3
630	15.7	15.4	−.3
620	15.5	15.2	−.3
610	15.3	15.0	−.3
600	15.0	14.8	−.2
590	14.8	14.6	−.2
580	14.6	14.4	−.2
570	14.4	14.2	−.2
560	14.1	13.9	−.2
550	13.8	13.8	−.1
540	13.7	13.6	−.1
530	13.5	13.4	−.1
520	13.3	13.1	−.2
510	12.9	12.9	.0
500	12.6	12.7	.1
490	12.4	12.6	.3
480	12.1	12.5	.4
470	11.8	12.1	.2
460	11.6	11.7	.1
450	11.2	11.5	.3
440	10.9	11.2	.3
430	10.6	11.0	.4
420	10.1	10.9	.7
410	9.8	10.7	.9
400	8.0	10.5	2.5

*The differences were calculated from scores expressed to greater precision than the table shows and then rounded off. Thus, the differences may not equal the differences calculated from the tabled numbers.

Table A-6. SAT-V + M Scores (Unrounded) Corresponding to ACT Composite Scores

ACT Composite Score	*Total Sample*		*Subsample That Took the ACT Assessment and the SAT No More Than 217 Days Apart*		
	Unweighted (N = 40,492)	*Smoothed Unweighted (N = 40,492)*	*Unweighted (N = 40,051)*	*Weighted (N = 40,051)*	*Smoothed Weighted (N = 40,051)*
36	1575	1565	1575	1571	1563
35	1509	1509	1510	1512	1509
34	1459	1452	1459	1462	1453
33	1399	1399	1398	1400	1401
32	1347	1348	1347	1349	1350
31	1301	1300	1301	1302	1302
30	1255	1255	1255	1257	1257
29	1211	1212	1211	1212	1213
28	1169	1169	1169	1170	1171
27	1128	1128	1128	1129	1130
26	1087	1088	1087	1089	1089
25	1046	1047	1047	1049	1049
24	1006	1006	1006	1008	1008
23	965	964	965	968	967
22	922	921	922	925	925
21	878	878	879	882	881
20	832	833	832	835	837
19	786	787	786	790	791
18	739	740	739	743	745
17	692	693	692	697	698
16	646	646	647	652	651
15	603	600	604	608	605
14	558	555	558	561	559
13	513	513	513	514	516
12	472	473	472	473	476
11	439	440	440	440	441
10	406	415	406	405	416
9	400	402	400	400	402
8	400	400	400	400	400
7	400	400	400	400	400
6					
5					
4					
3					
2					
1					

Table A-7. ACT Composite Scores (Unrounded) Corresponding to SAT-V + M Scores

SAT-V + M Score	Total Sample		Subsample That Took the ACT Assessment and the SAT No More Than 217 Days Apart		
	Unweighted (N = 40,492)	Smoothed Unweighted (N = 40,492)	Unweighted (N = 40,051)	Weighted (N = 40,051)	Smoothed Weighted (N = 40,051)
1600					
1590	36.0	36.0	36.0	36.0	36.0
1580	36.0	36.0	36.0	36.0	36.0
1570	35.9	36.0	35.9	36.0	36.0
1560	35.6	35.9	35.6	35.7	35.9
1550	35.5	35.6	35.5	35.5	35.7
1540	35.4	35.4	35.4	35.4	35.5
1530	35.3	35.3	35.3	35.3	35.3
1520	35.2	35.2	35.2	35.2	35.2
1510	35.0	35.0	35.0	34.9	35.0
1500	34.8	34.8	34.7	34.6	34.8
1490	34.5	34.6	34.5	34.4	34.6
1480	34.3	34.4	34.3	34.3	34.4
1470	34.2	34.3	34.2	34.1	34.3
1460	34.0	34.1	34.0	34.0	34.1
1450	33.8	34.0	33.8	33.8	33.9
1440	33.6	33.7	33.6	33.6	33.7
1430	33.5	33.5	33.5	33.4	33.5
1420	33.3	33.4	33.3	33.3	33.3
1410	33.2	33.2	33.2	33.2	33.2
1400	33.0	33.0	33.0	33.0	33.0
1390	32.8	32.8	32.8	32.8	32.8
1380	32.6	32.6	32.6	32.6	32.5
1370	32.4	32.4	32.4	32.4	32.4
1360	32.3	32.2	32.3	32.2	32.2
1350	32.1	32.0	32.1	32.0	32.0
1340	31.9	31.8	31.9	31.8	31.8
1330	31.6	31.6	31.6	31.6	31.5
1320	31.4	31.4	31.4	31.4	31.4
1310	31.2	31.2	31.2	31.2	31.2
1300	31.0	31.0	31.0	30.9	31.0
1290	30.8	30.8	30.8	30.7	30.7
1280	30.5	30.5	30.5	30.5	30.5
1270	30.3	30.3	30.3	30.3	30.3
1260	30.1	30.1	30.1	30.1	30.1
1250	29.9	29.9	29.9	29.8	29.8
1240	29.6	29.6	29.6	29.6	29.6
1230	29.4	29.4	29.4	29.4	29.4
1220	29.2	29.2	29.2	29.2	29.2
1210	29.0	29.0	29.0	28.9	28.9
1200	28.7	28.7	28.7	28.7	28.7
1190	28.5	28.5	28.5	28.5	28.4
1180	28.3	28.2	28.3	28.2	28.2
1170	28.0	28.0	28.0	28.0	28.0
1160	27.8	27.8	27.8	27.8	27.7
1150	27.5	27.5	27.5	27.5	27.5
1140	27.3	27.3	27.3	27.3	27.2
1130	27.1	27.0	27.0	27.0	27.0
1120	26.8	26.8	26.8	26.8	26.8
1110	26.5	26.5	26.5	26.5	26.5
1100	26.3	26.3	26.3	26.3	26.3
1090	26.1	26.1	26.1	26.0	26.0
1080	25.8	25.8	25.8	25.8	25.8
1070	25.6	25.6	25.6	25.5	25.5
1060	25.3	25.3	25.3	25.3	25.3
1050	25.1	25.1	25.1	25.0	25.0
1040	24.8	24.8	24.8	24.8	24.8
1030	24.6	24.6	24.6	24.5	24.5
1020	24.4	24.3	24.3	24.3	24.3
1010	24.1	24.1	24.1	24.0	24.0
1000	23.8	23.9	23.8	23.8	23.8

Table A-7. (Continued)

SAT-V + M Score	Total Sample		Subsample That Took the ACT Assessment and the SAT No More Than 217 Days Apart		
	Unweighted (N = 40,492)	Smoothed Unweighted (N = 40,492)	Unweighted (N = 40,051)	Weighted (N = 40,051)	Smoothed Weighted (N = 40,051)
990	23.6	23.6	23.6	23.5	23.6
980	23.4	23.4	23.3	23.3	23.3
970	23.1	23.1	23.1	23.0	23.1
960	22.9	22.9	22.9	22.8	22.8
950	22.6	22.7	22.6	22.6	22.6
940	22.4	22.4	22.4	22.3	22.4
930	22.2	22.2	22.2	22.1	22.1
920	22.0	22.0	21.9	21.9	21.9
910	21.7	21.7	21.7	21.6	21.7
900	21.5	21.5	21.5	21.4	21.4
890	21.3	21.3	21.2	21.2	21.2
880	21.0	21.1	21.0	21.0	21.0
870	20.8	20.8	20.8	20.8	20.7
860	20.6	20.6	20.6	20.6	20.5
850	20.4	20.4	20.4	20.3	20.3
840	20.2	20.2	20.2	20.1	20.1
830	20.0	19.9	20.0	19.9	19.9
820	19.7	19.7	19.7	19.7	19.6
810	19.5	19.5	19.5	19.5	19.4
800	19.3	19.3	19.3	19.2	19.2
790	19.1	19.1	19.1	19.0	19.0
780	18.9	18.9	18.9	18.8	18.8
770	18.7	18.7	18.7	18.6	18.6
760	18.5	18.5	18.5	18.4	18.3
750	18.2	18.2	18.2	18.2	18.1
740	18.0	18.0	18.0	17.9	17.9
730	17.8	17.8	17.8	17.7	17.7
720	17.6	17.6	17.6	17.5	17.5
710	17.4	17.4	17.4	17.3	17.3
700	17.2	17.2	17.2	17.1	17.1
690	17.0	16.9	17.0	16.9	16.8
680	16.8	16.7	16.8	16.7	16.6
670	16.6	16.6	16.6	16.5	16.5
660	16.3	16.3	16.3	16.2	16.2
650	16.1	16.1	16.1	16.0	16.0
640	15.9	15.9	15.8	15.7	15.8
630	15.6	15.7	15.6	15.5	15.6
620	15.4	15.5	15.4	15.3	15.4
610	15.2	15.2	15.1	15.0	15.1
600	14.9	15.0	14.9	14.8	14.9
590	14.7	14.8	14.7	14.6	14.7
580	14.5	14.6	14.5	14.4	14.5
570	14.3	14.4	14.3	14.2	14.3
560	14.1	14.1	14.0	14.0	14.0
550	13.8	13.9	13.8	13.8	13.8
540	13.6	13.7	13.6	13.6	13.6
530	13.5	13.5	13.5	13.4	13.4
520	13.2	13.2	13.2	13.2	13.1
510	12.9	12.9	12.9	12.9	12.9
500	12.7	12.7	12.7	12.7	12.6
490	12.5	12.5	12.5	12.5	12.4
480	12.3	12.2	12.2	12.2	12.1
470	11.9	11.9	11.9	11.9	11.8
460	11.7	11.7	11.6	11.6	11.6
450	11.4	11.4	11.4	11.3	11.3
440	11.0	11.0	11.0	11.0	11.0
430	10.7	10.7	10.7	10.8	10.6
420	10.6	10.3	10.6	10.7	10.2
410	10.3	9.7	10.3	10.5	9.7
400	9.5	8.8	9.5	9.6	8.7